



Total System Performance Assessment

Mission

Demonstrate that spent nuclear fuel can be safely isolated to protect the health and safety of the public and the environment as required by regulations

Benefits

- Successful license application process
- Well defined research priorities to illustrate that spent nuclear fuel can safely be dispositioned in a geologic repository

Current Issues

Understand and finalize the principal factors that should be considered in the site recommendation and license application

Project Status

- Viability assessment completed
- Site recommendation in progress

Purpose

Before the U.S. Department of Energy (DOE)-owned spent nuclear fuel (SNF) can be accepted by the national repository, DOE must show with reasonable assurance that the repository system can safely isolate fuel from the environment using Total System Performance Assessment (TSPA).

Project Description

TSPA forecasts how a repository's engineered design will contain SNF. This iterative process demonstrates compliance with regulatory requirements and determines the relative influence of the repository characteristics and spent fuel types on the repository system's performance. Scientists use this information to determine research priorities based on high-risk and significant variables.

TSPA includes several steps. First, DOE develops an engineering design for the repository based on the characteristics of the SNF and the potential repository location.

Next, scientists and engineers determine the release and migration paths of radionuclides to the environment (e.g., the interaction among the SNF, barriers, natural geologic medium, biosphere, and humans during a reasonable range of circumstances). They then study the behavior and evolution of the repository system, identify scenarios, and develop simulations of repository system behavior.

Scientists and engineers next document the safety of the repository design regarding potential radiological consequences and their likelihood to occur.

The analyst then performs uncertainty analyses to refine the assessment. These analyses account for items such as the possible omission of important features, events, and processes; faulty interpretation of geology; and failure to realistically estimate probabilities of occurrence.

Finally, scientists and engineers validate all components of the TSPA, comparing the results with the regulatory requirements and design goals.

DOE performs the TSPA with and without the DOE-owned SNF for the proposed national repository. These assessments determine how the DOE-owned SNF may affect the performance of the repository system. To validate that the DOE-owned SNF behaves as modeled in the TSPA, the National SNF Program is currently determining the degradation and radionuclide release behavior of the DOE-owned SNF in simulated repository conditions. In addition, the program is conducting sensitivity analyses to establish best management practices for the DOE-owned SNF types during preparation for repository acceptance.

Benefits

These performance assessment analyses are required to achieve repository acceptance of all DOE-owned SNF. The National SNF Program is applying its experience and research to support the license application process for repository acceptance. Program experience in defining high-risk research priorities contributes to ensure the safe disposal of DOE-owned SNF in a geologic repository.



Unique Capabilities

The National SNF Program has extensive knowledge about the DOE SNF types. Its science and engineering expertise accurately identify the high-risk and most significant performance assessment variables and determine the effects that treatment, packaging, and other factors may have on the long-term radiological consequences to the repository system.

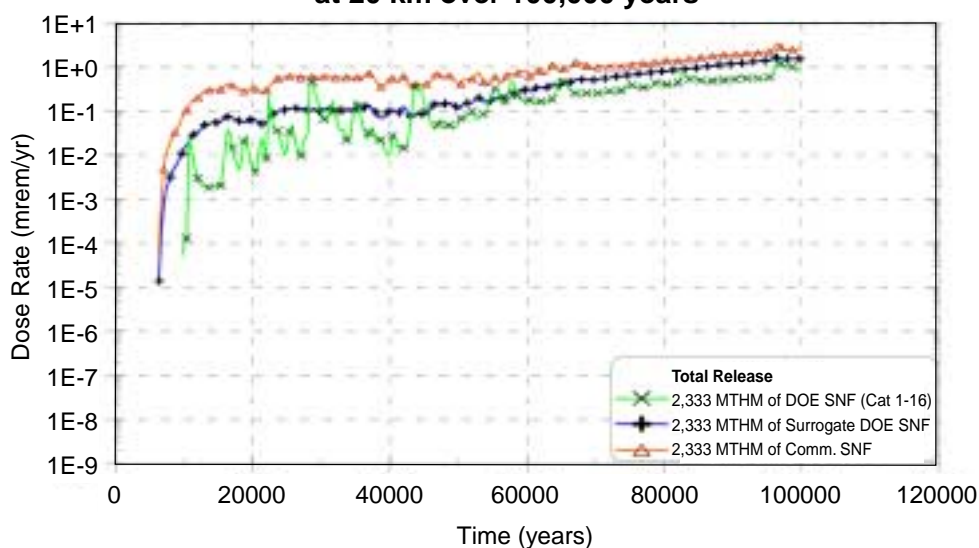
Project Status

DOE performed a TSPA as part of the viability assessment completed in December 1998. They considered the following comprehensive set of parameters for evaluation in the viability assessment:

- Seepage into drifts
- Performance of the drip shield
- Performance of spent fuel package barriers
- Solubility limits of dissolved radionuclides
- Retardation of radionuclide migration in the unsaturated zone
- Retardation of radionuclides in the saturated zone
- Dilution of radionuclide concentrations during migration.

DOE is considering a similar comprehensive set of factors for the Site Recommendation TSPA. Thus far, sensitivity studies continue to demonstrate that degradation of the DOE-owned SNF is not a principal factor in determining repository post-closure safety.

**Expected-value total dose rate history
at 20 km over 100,000 years**



The result of a typical TSPA expected-value dose history curve.

December 1998

Viability Assessment completed

July 1999

Draft of Environmental Impact Statement completed

October 2000

Environmental Impact Statement finalized

November 2000

Department of Energy publishes notice on site recommendation hearing and requests comments from states

June 2001

Secretary of Energy decides on site recommendation

Department of Energy notifies states of decision

July 2001

Department of Energy submits site recommendation to the President

January 2003

DOE submits license application to Nuclear Regulatory Commission

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